OPERATION AND SERVICE MANUAL

MODEL 3210
ATTENUATOR CONTROLLER

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MODEL 3210
ATTENUATOR CONTROLLER

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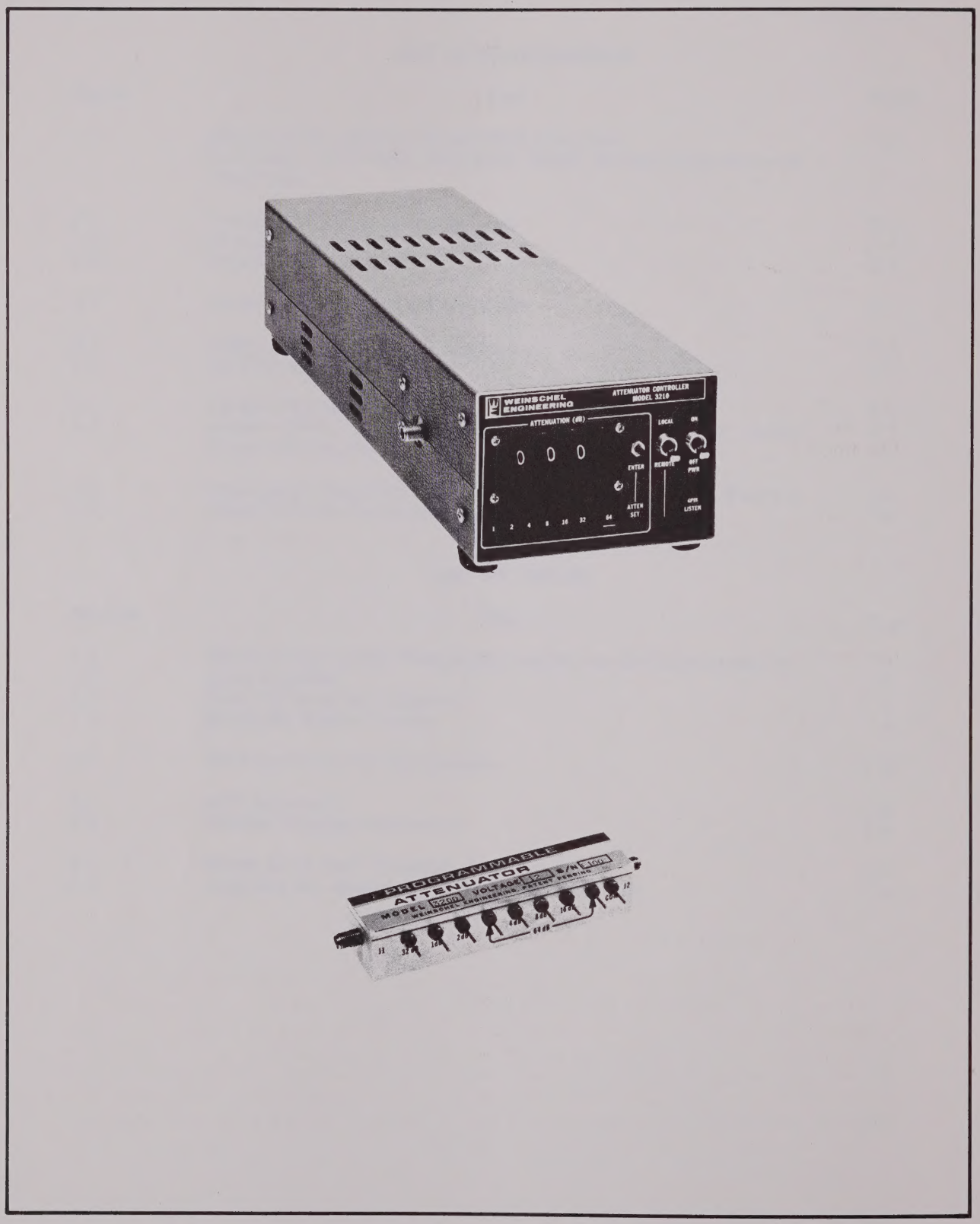

Figure 1-1. Weinschel Engineering Model 3210 Attenuator Controller (Including Accessory 3200 Series Programmable Attenuator)

SECTION 1
GENERAL INFORMATION

1.1 INTRODUCTION

The Weinschel Engineering Model 3210 Attenuator Controller (see Figure 1-1) is used in conjunction with a Weinschel Engineering Model 3200 Series Programmable Attenuator. The attenuation range of the Model 3210 Attenuator Controller (hereafter referred to as the 3210 is dependent on the 3200 Programmable Attenuator (hereafter referred to as the 3200). The attenuation range of the 3200 series is from .5 to 127 dB. The front panel thumbwheel switch of the 3210 provides the attenuation setting of the 3200 series attenuator in the LOCAL control mode. A REMOTE control mode is also provided. The GPIB connector on the rear panel of the 3210 provides for an IEEE 488 interface. A remote controller is used to determine the attenuation setting of the 3200 series attenuator through the 488 interface. The combination of a 3210 controller and a 3200 attenuator is designed for the attenuation of RF signals from automatic test equipment or OEM systems operating in the dc to 2 GHz frequency range.

One of the 3200 series attenuators is also shown in Figure 1-1. The 3210 software is designed to accommodate a 3200 attenuator in conjunction with the users application (attenuation range). The standard 3210 software is designed for the 3200-1 attenuator which provides a 1 to 127 dB range in 1 dB steps.

All references in this manual to the Model 3210 pertain to the Model 3210 and the Model 3210-01. Where differences exist between the Model 3210 and Model 3210-01, these differences are described, as required, in the appropriate sections of this manual.

1.2 DESCRIPTION

The 3210 is a single unit configuration consisting of:

a. A Model 3210 control unit, that serves as a local or remote operated controller for one 3200 attenuator.

b. A Model 3200 programmable attenuator.

1.2.1 Model 3210 Attenuator Controller

A solid state bench mount assembly, the Model 3210 Attenuator Controller may be set on a flat surface which is a short distance from a 115V or 230V AC power source. The power supply and the single printed circuit card are mounted within the 3210. All control signals necessary to change the attenuation setting in the LOCAL operating mode are generated within the 3210 in accordance with the operator manipulation of the front panel controls. In the REMOTE operating mode the control signals are applied to the 3210 rear panel GPIB connector from a remote controller. These control signals are interpreted by the microprocessor, and appropriate control signals are generated and applied to the Model 3200, during LOCAL or REMOTE operation.

1.2.2 Model 3200 Programmable Attenuators

This Series is available in five standard attenuation ranges and cell configurations. Custom designed configurations are available upon request. Each cell contains a standard TO-5 type double-pole, double-throw relay that provides a minimum loss or attenuated path for the RF signal.

Microstrip circuitry and special compensation techniques produce flat attenuation versus frequency characteristics. The microstrip construction, using thick-film circuit elements, assures product uniformity and minimizes special hand work usually required to achieve the performance specified. The frequency range for all five models is dc to 2 GHz at a characteristic impedance of 50 ohms nominal Refer to Table 1-1 for the attenuation range, increments and cell configurations of the five models.

TABLE 1-1. STANDARD ATTENUATION RANGES, INCREMENTS, AND CELL CONFIGURATIONS:

Model No.	Cells	Cell Increments (dB)	Total Attenuation/ Step Increments (dB)
3200-1	8	1,2,4,8,16,32, and 64*	127/1
3200-2	8	1,2,4,6,16,32, 0.5 and 0.25	63.75/0.25
3201-1	5	1,2,4,8, and 16	31/1
3201-2	5**	10,20,30, and 60**	120/10
3202-1	1	0.5	0.5/0.5

* 64 dB cell comprised of two 32 dB cells
** 60 dB cell comprised of two 30 dB cells

1.3 ITEMS SUPPLIED

Items supplied with the Model 3210 are listed in Table 1-2.

TABLE 1-2 ITEMS SUPPLIED

Qty	Description	W/E Part No./Model No.
1	Attenuator Control Board Assembly	D101-1156

1.4 REQUIRED ITEMS NOT SUPPLIED

Required items that are not supplied with the Model 3210 are listed in Table 1-3.

TABLE 1-3 REQUIRED ITEMS NOT SUPPLIED

Qty	Description	W/E Part No./Model No.
1	Programmable Attenuator	Refer to Table 1-1 for Part/Model numbers

1.5 SPECIFICATIONS

Table 1-4 lists the pertinent technical specifications for the Model 3210.

TABLE 1-4. MODEL 3210 SPECIFICATIONS

Frequency Range: dc to 2 GHz

Characteristic Impedance: 50 ohms, nominal for all 3200 series attenuators.

Standard Attenuation Ranges, Increments, and Cell Configurations in accordance with one of the five 3200 series attenuators.

Model No.	Cells	Cell Increments (dB)	Total Attenuation/ Step Increments (dB)
3200-1	8	1,2,4,8,16,32, and 64*	127/1
3200-2	8	1,2,4,6,16,32 0.5, and 0.25	63.75/0.25
3201-1	5	1,2,4,8, and 16	31/1
3201-2	5**	10,20,30, and 60**	120/10
3202-1	1	0.5	0.5/0.5

* 64 dB cell comprised of two 32 dB cells
** 60 dB cell comprised of two 30 dB cells

3200 Series Accuracy of Incremental Attenuation: dc to 0.5 GHz: ±0.2 dB or 1/2%, whichever is greater.
0.5 to 1 GHz: ±0.2 dB or 1%, whichever is greater
1 to 2 GHz: ±0.3 dB or 2%, whichever is greater

3200 Series Power Capability: 1 watt average, 100 watts peak

3200 Series Rated Switch Life: 10^7 operations per cell

3200 Series Switching Speed: 6 msec maximum at 12.0 Vdc

3200 Series Operating Voltage: 9 Vdc minimum, 12 Vdc nominal and 20 Vdc maximum

3200 Series Operating Current: 14 mA all cells (except 64 dB and 60 dB, require 28 mA).

3200 Series Control Configuration: one terminal is provided for a common return and is connected to case ground. The remaining terminals are provided for activation of individual cells. Attenuation is fail-safe to "0" setting in the absence of a control voltage. Application of voltage (+ or –) to a particular cell causes it to switch to the attenuate position.

Note — control is non-latching and requires a continuous control signal for the period of time in which attenuation is required.

Monotonicity: dc to beyond 1.5 GHz

Characteristic Zero Insertion Loss, Maximum (dB):

Model Number	3200-1 and -2	3201-1 and -2	3202-1
dc to 0.5 GHz	3.0	2.25	0.5
0.5 to 1 GHz	3.5	2.75	0.6
1.0 to 1.5 GHz	4.25	3.25	0.75
1.5 to 2 GHz	4.75	3.75	0.75

VSWR: dc to 1 GHz: 1.25:1
1 to 2 GHz: 1.35:1

Temperature Range (Operating): 0°C to +50°C

Connectors:

RF: Stainless-steel female SMA mates with male SMA per MIL-C-39012.

Control:* 1mm (0.040-inch) diameter tinned copper wire for soldering or use with PC board jacks.

GPIB: 24 pin multipin connector
*3200 Series

Power Requirements: 115/230 volts, 48 to 62 Hz

Weight: Approximately 4 lbs.

Dimensions: Approximately 3" high x 4" wide x 11" deep including the front panel toggle switches and the rear panel GPIB connector

GPIB Compatible:

1. Uses decimal ASCII format
2. Tests for validity of data
3. Responds with identification of error
4. LISTENING function
5. Serial Poll
6. Acceptor and Source handshake
7. Remote and Local function

SECTION 2
INSTALLATION

2.1 GENERAL

The Model 3210 is shipped in a double carton and is cushioned between molded-in-place plastic pads. Do not destroy the cartons or packing material until the equipment is thoroughly inspected and it is determined that reshipment is not necessary.

Installation of the Model 3210 requires that each unit be separately installed, then interconnected by appropriate cabling. The power cable is a standard item supplied with each unit. The GPIB cable and the RF signal cables are accessory items which are purchased separately.

There are no special power considerations for the Model 3210 unit. Operating power from a standard 115 volt or 230 volt AC source is acceptable.

2.2 OPERATING TEMPERATURE RANGE

The Model 3210 is designed to operate within its specifications when the ambient temperature is between 0°C to 50°C. Operating in ambient temperatures beyond these limits could affect the accuracy of the 3210 and/or cause damage to its circuits.

2.3 INSTALLING THE MODEL 3210

The Model 3210 is designed for test bench installation. The unit may be placed on a flat surface located within the power cable length of a 115V or 230V AC source. Proper installation requires that the Voltage Selection Switch, S6, located on the rear panel, be set at the proper voltage for the power source to be used, and that the proper corresponding line-voltage fuse, F1, is installed on the P.C. board. Toggle S6 to the right for 115V operation and to the left for 230V operation. The fuse requirements are as follows: for 115V - 1/4 Amp; for 230V - 1/8 Amp. For remote operation, the cable length of the GPIB interface cable must also be considered. The RF signal cables are connected to the threaded attenuator connectors of the 3200. The four bumper feet on the bottom of the unit are the only mounting materials required. The unit does not require blower cooling air. However, adequate clearance should be maintained on the side panels to permit heat venting through the side panel cutouts. For fixed test bench installations, front and rear panel clearance that will permit the manipulation of controls and the connection of the GPIB cable is recommended. Refer to Figure 2-1 for a perimeter illustration of the 3210.

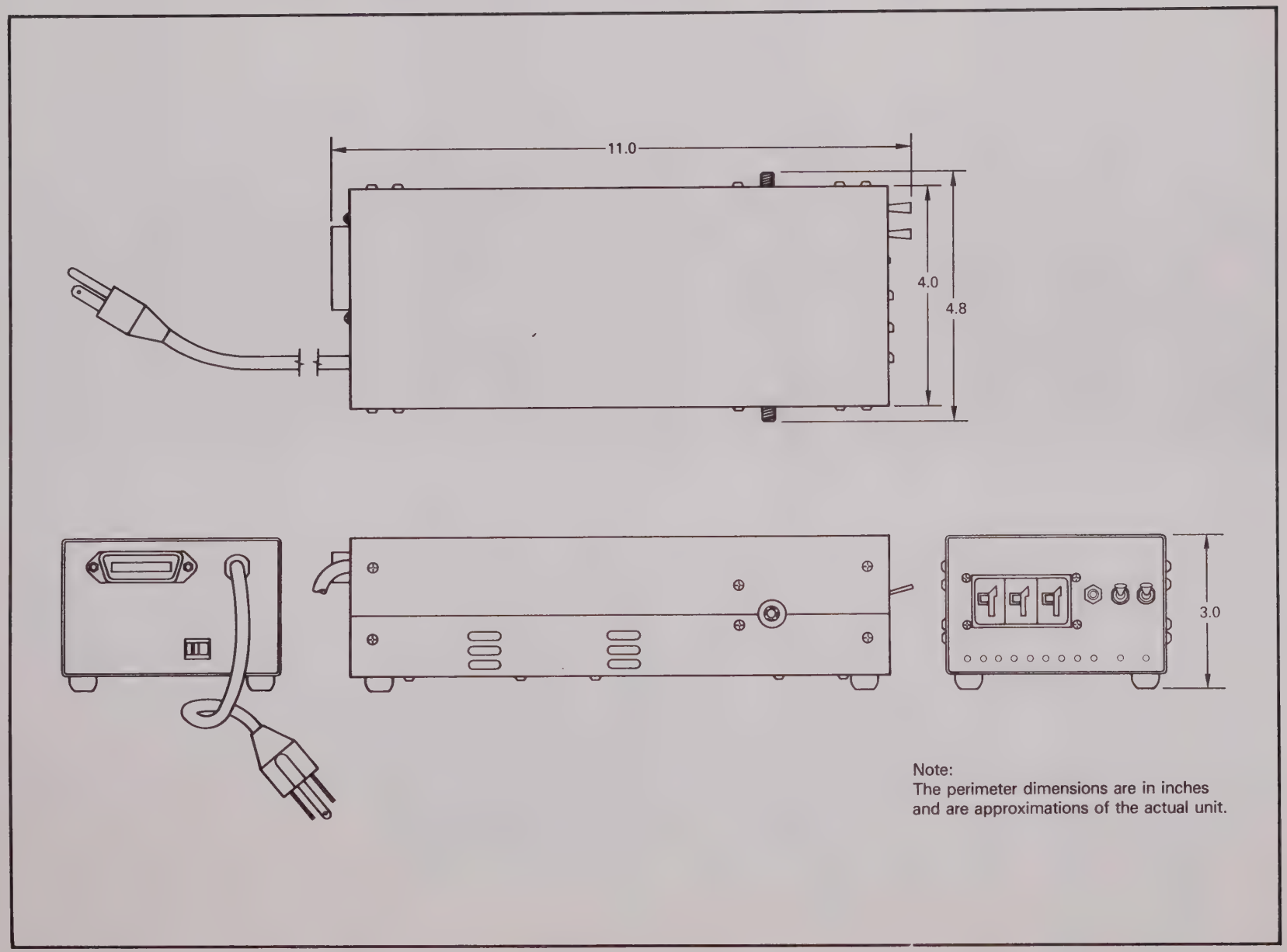

Figure 2-1. Model 3210 Perimeter Dimensions

2.4 REPLACEMENT PROCEDURE FOR THE MODEL 3200

The Model 3200 is installed inside the chassis of the 3210.

a. Remove the six screws which secure the top cover to the 3210 chassis. Three of the six screws are located on each side of the 3210. Refer to Figure 2-1 for a side view of the 3210.

b. Lift the top cover off the 3210 chassis.

c. The 3200 attenuator is mounted to the 3210 bottom cover side panels by two attenuator mounts. Remove the side panel screw that threads into eachattenuator mount through the bottom cover side panel. One of the two screws is visible in the 3210 side view of Figure 2-1.

d. Refer to Figure 2-2 for step d. Remove the ribbon cable 16 pin connector P1 from the 16 pin I.C. socket J1 by pulling the connector out of the socket. This step will prevent ribbon cable damage, when the 3200 is removed from the printed circuit card.

e. Pull the 3200 attenuator out of the printed circuit card. The 3200 pin guide is a physical part of the printed circuit card.

f. Remove the two screws which fasten each attenuator mount to the 3200.

g. This completes the 3200 removal procedure. To replace a 3200 in the 3210 reverse the order of steps f through a.

2.5 CONNECTIONS

a. Connect one end of the GPIB cable to the multi-pin connector on the remote controller; connect the other end of the cable to multi-pin connector J1 (GPIB) on the rear panel of the 3210. The pin assignments of the 3210 multipin connector are in accordance with the IEEE 488 interface standard. Refer to Table 2-1 for the GPIB connector pin assignments, and Figure 2-3 for a rear panel view of the 3210.

b. Prior to connecting the three prong power plug to a 115V or 230V AC source check the rating of fuse F1. A 1/4A fuse is used for 115V power, and a 1/8A fuse is used for 230V power. Install the required fuse, and set the voltage select switch (S6) in conjunction with the available source

c. Connect one RF signal cable between the RF signal source of the equipment under test and a threaded connector of the 3200. The other RF signal cable is connected between the RF input of the test equipment and the remaining connnector of the 3200. Refer to Figure 2-2 for the location of the 3200 attenuator connectors.

2.6 ADDRESS SWITCH

The ADDRESS switch is located behind the front panel on the right side between the front panel and the 3200 module (see figure 2-2). This switch is a seven section miniature DIP switch which must be set for compatibility with a controller when operating the 3210 under IEEE-488 bus control. Such remote operation requires programming the 3210 Bus interface for a unique bit address. The five-bit address word is coded via switch sections 1-5, Section 1 being the LSB Addresses 0-30 are valid, and address 31 puts 3210 in LISTEN mode and it answers to any address. To code a particular address, set switch sections to either ON or OFF to code a binary 1 or 0 respectively. Figure 2-4 is a view of the address switch showing the section numbering scheme. Figure 2-5 is the truth table which defines the binary word to be coded for each address

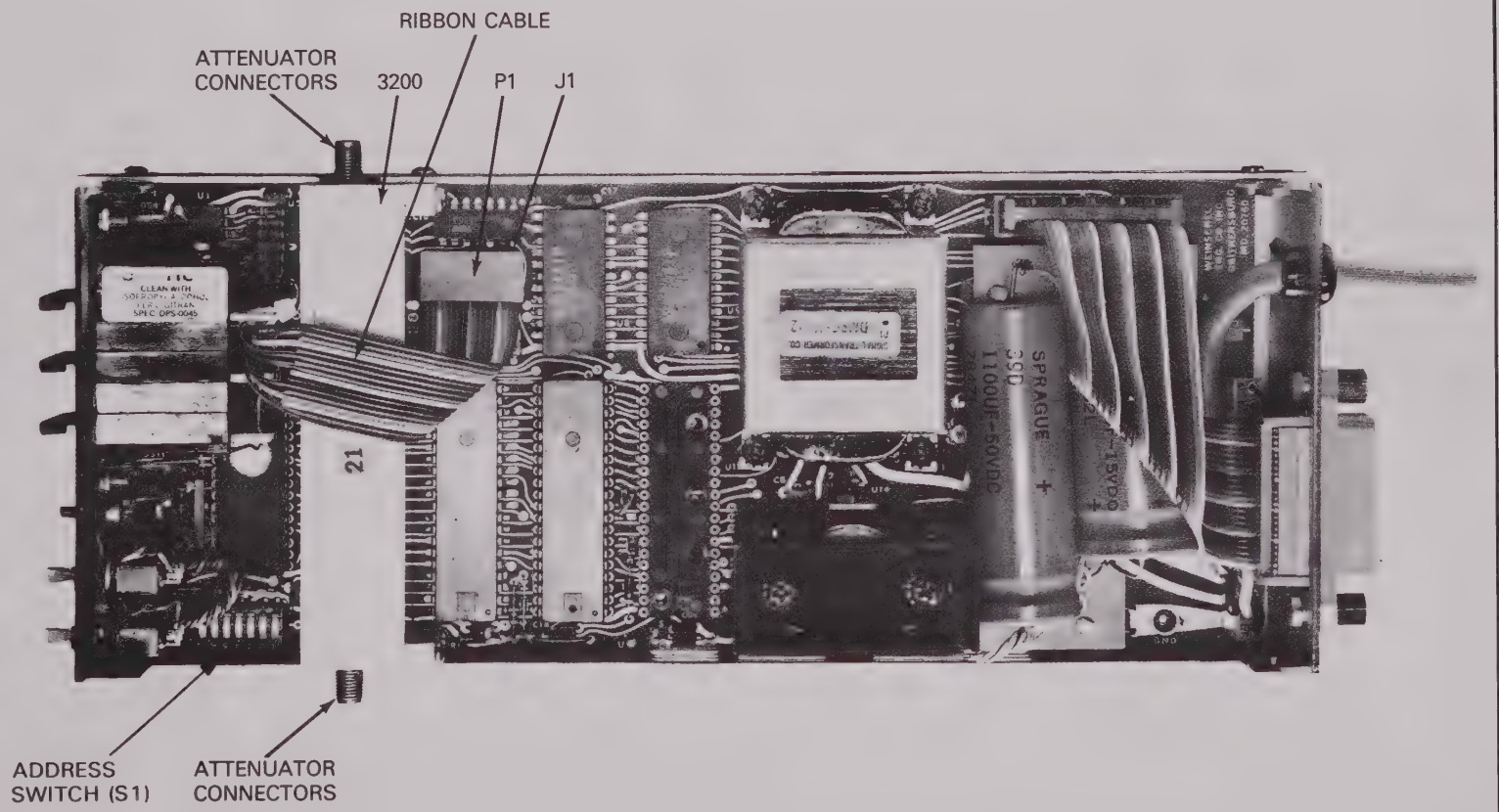

Figure 2-2. Model 3210 Top Cover Removed

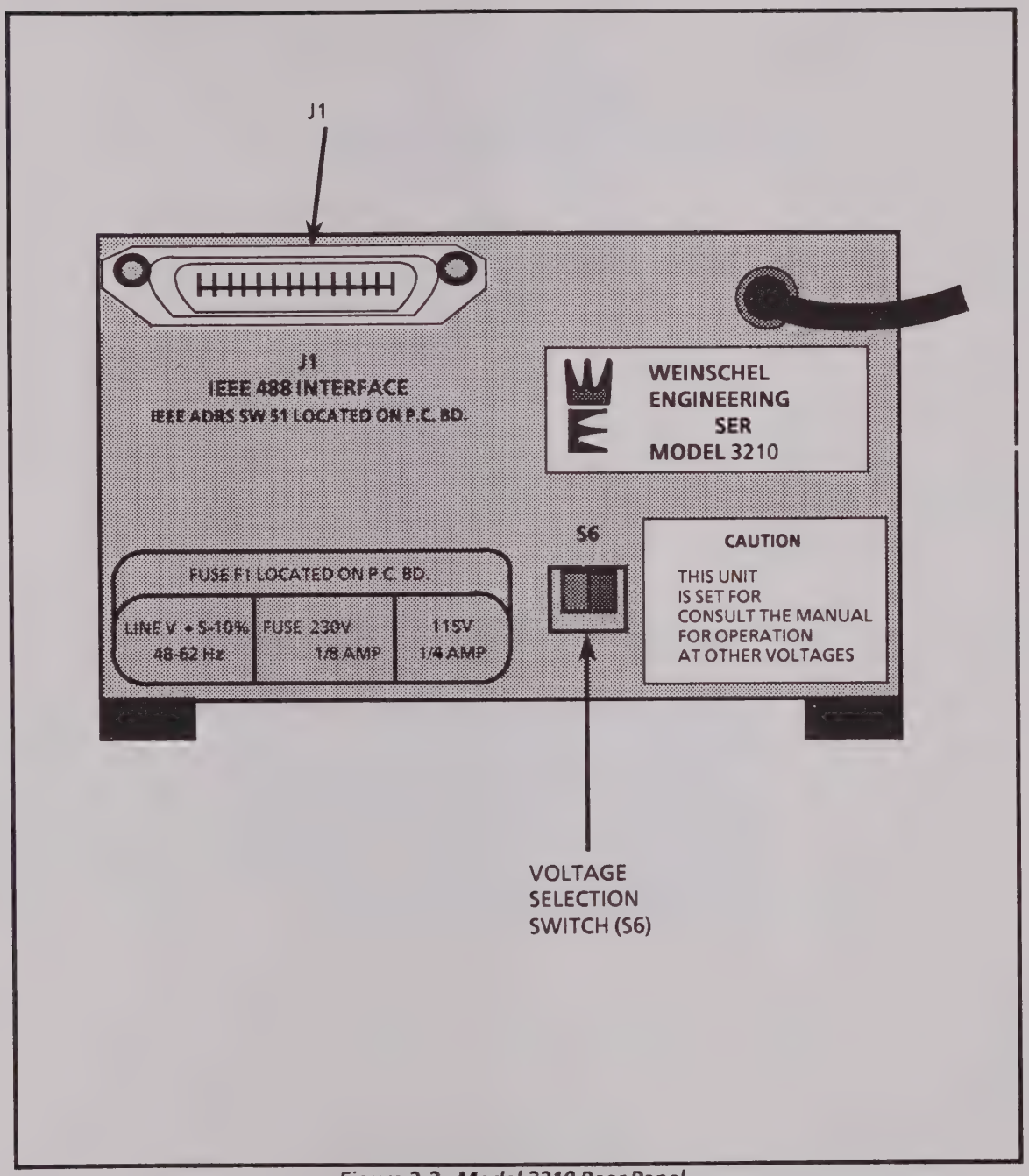

Figure 2-3. Model 3210 Rear Panel

TABLE 2-1 GPIB CONNECTOR PIN ASSIGNMENTS

Pin No.	IEEE 488 Interface Descriptions*
1	DIO1 data input output 1
2	DIO2 data input output 2
3	DIO3 data input output 3
4	DIO4 data input output 4
5	EOI (24) end or identify
6	DAV data valid
7	NRFD not ready for data
8	NDAC not data accepted
9	IFC interface clear
10	SRQ service request
11	ATN attention
12	GND shield
13	DIO5 data input output 5
14	DIO6 data input output 6
15	DIO7 data input output 7
16	DIO8 data input output 8
17	REN (24) remote enable
18	GND (6)
19	GND (7)
20	GND (8)
21	GND (9)
22	GND (10)
23	GND (11)
24	LOGIC GND

* The GPIB (J1) connector pin assignments are in accordance with the IEEE 488 interface standard. The interface contains a set of sixteen signal lines used to carry all information, interface messages, and devise dependent messages between the remote controller and the 3210. The signal names and descriptions are specified by the IEEE and are divided into three sets of signal lines: data bus, handshake and general interface management. The data bus signal lines include DIO1 through DIO8. DAV, NRFD and NDAC signal lines are the handshake. General interface management signal lines include IFC, ATN, SRQ, REN and EOI. The numerical information in parenthesis is the pin number of the signal line the Gnd corresponds to. EOI and REN return on pin number 24.

SECTION 3
OPERATING INSTRUCTIONS

3.1 INTRODUCTION

This section provides a detailed discussion of the operating controls and indicators which are part of the 3210.

3.2 PANEL DESCRIPTION

3.2.1 Model 3210

Refer to Figure 3-1 for the location and an explanation of the 3210 controls and indicators.

3.2.2 Model 3200

The 3200 series attenuators do not contain controls or indicators. They are incapable of independent operation and rely on the parent equipment, (i.e. 3210) for control signals.

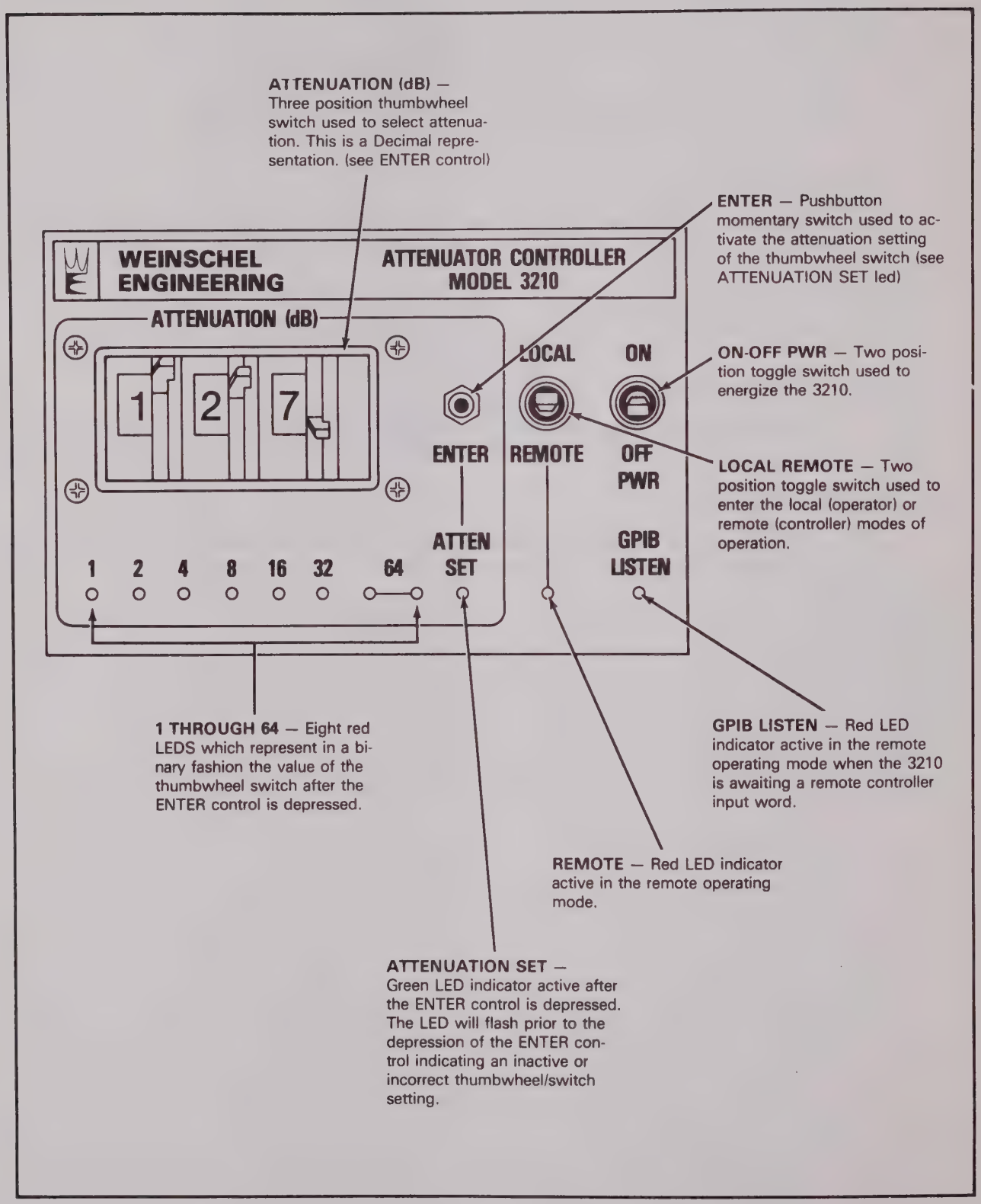
ATTENUATION (dB) — Three position thumbwheel switch used to select attenuation. This is a Decimal representation. (see ENTER control)
ENTER — Pushbutton momentary switch used to activate the attenuation setting of the thumbwheel switch (see ATTENUATION SET led)
ON-OFF PWR — Two position toggle switch used to energize the 3210.
LOCAL REMOTE — Two position toggle switch used to enter the local (operator) or remote (controller) modes of operation.
WEINSCHEL ENGINEERING
ATTENUATOR CONTROLLER MODEL 3210
ATTENUATION (dB)
1
2
7
LOCAL
ON
ENTER
REMOTE
OFF PWR
ATTEN SET
GPIB LISTEN
1 2 4 8 16 32 64
1 THROUGH 64 — Eight red LEDS which represent in a binary fashion the value of the thumbwheel switch after the ENTER control is depressed.
GPIB LISTEN — Red LED indicator active in the remote operating mode when the 3210 is awaiting a remote controller input word.
REMOTE — Red LED indicator active in the remote operating mode.
ATTENUATION SET — Green LED indicator active after the ENTER control is depressed. The LED will flash prior to the depression of the ENTER control indicating an inactive or incorrect thumbwheel/switch setting.

Figure 3-1. Model 3210 Front Panel Description

3.3 MODEL 3210 UNIT OPERATION

Once the Model 3210 is installed in accordance with the instructions given in Section 2 the operator can proceed with the following operation instructions. These instructions are for LOCAL mode operation of the 3210. For REMOTE mode operation set the LOCAL REMOTE control to REMOTE and refer to the documentation of the remote controller.

a. Set the ON OFF PWR switch to the ON position. The illumination of one or more front panel LEDs is an indication that the 3210 is energized.

b. Set the LOCAL REMOTE switch to LOCAL.

c. Set the three position thumbwheel ATTENUATION (dB) switch to the required attenuation setting. The attenuation setting is limited to the attenuation range of the 3200 installed in the 3210. (Refer to Table 1-1 for the 3200 series attenuation ranges). The least significant digit is set by the thumbwheel switch closest to the ENTER control. The attenuation setting shown in Figure 3-1 is 127 dB. This setting is the attenuation maximum of the 3200-1 attenuator and, is therefore the maximum attenuation value available from the 3210.

d. To set the 3210 to the attenuation value shown on the thumbwheel switch depress the ENTER control. This will stop the flashing of the green ATTENuation SET LED, and cause the illumination of the red digital number LEDs. The red LEDs will illuminate the binary equivalent in accordance with the thumbwheel switch setting (ie — for a 127 dB setting all red digit LEDs will illuminate).

e. To establish a different attenuation setting, select the new value on the thumbwheel switch and depress the ENTER control.

NOTE

The attenuation setting of the thumbwheel switch is not active until the ENTER control is depressed. The continuous illumination of the green ATTENuation SET LED is the indication of an active attenuation setting. A flashing ATTENuation SET LED is the indication for an inactive or incorrect attenùation setting on the thumbwheel switch. An incorrect setting is above or below the attenuation range of the 3200 (ie 128 dB)

This completes the LOCAL mode operating procedure for the 3210.

SECTION 4
PRINCIPLES OF OPERATION

4.1 INTRODUCTION

The Weinschel Engineering Model 3210 attenuator controller consists of a single unit within which a 3200 series programmable attenuator is mounted. The 3210 contains all the circuitry required to interface with the 3200. The major circuits of the 3210 are discussed in reference to an overall block diagram (Figure 4-1). The block diagram discussion is presented first to provide an overall understanding of circuit functions, then each of the major circuits is described in detail, with supporting schematic diagrams provided in Section 7.

4.2 OVERALL BLOCK DIAGRAM DESCRIPTION

The overall block diagram, Figure 4-1, includes major circuits within the Model 3210 mainframe and shows their interrelationship with the 3200 attenuator, the front panel controls (LOCAL operation) and the rear panel GPIB connector J1 (REMOTE operation). Referring to the "3210 Front Panel " portion of Figure 4-1, in the LOCAL operating mode, the operator manipulation of the thumbwheel switch provides a nine bit parallel transfer input to the programmable peripheral interface circuit. In conjunction with the trigger input of the front panel ENTER switch the microprocessor, in accordance with the instructions of the ROM, reads the thumbwheel switch data via the peripheral interface circuit and converts the data from BCD to binary. The data is then applied to the input/output portion of the ROM circuit and in turn is applied to the driver circuit. The purpose of the driver circuit output is twofold. The output is used to activate the cells of the 3200 attenuator and to illuminate the front panel digital LEDS. This completes the LOCAL mode operation of the 3210 circuitry.

Refer to the "3210 Rear Panel" portion of Figure 4-1. In the REMOTE operating mode the attenuation setting of the 3200 Attenuator is determined by a remote controller and applied to the GPIB connector of the 3210. The GPIB connector is wired in accordance with the IEEE 488 interface standard and provides a connection between the 3210 and the remote controller. The remote controller attenuation setting data is applied to the transceiver and talker/listener circuit via the GPIB connector. In accordance with the data byte transfer control and general interface management signal lines of the 488 interface the microprocessor, in accordance with the instructions of the ROM, reads the talker/listener circuit and converts the data from BCD to binary. The attenuation setting data is then applied to the bidirectional data bus. From the bus the data signal path is the same for LOCAL and REMOTE operation. The data output of the input/output circuit is applied to the 3200 attenuator and the front panel digital leds via the driver circuit. This completes the REMOTE mode operation of the 3210 circuitry. For a listing of the remote message mnemonics (ie ATN) refer to Table 4-2. All remote messages via the IEEE-488 interface are represented by three letter mnemonics throughout the text.

The power supply circuit is activated by the front panel ON/OFF PWR switch. The AC source input of 115 volts or 230 volts is applied to the power supply circuit through the rear panel power cord. The power supply generates regulated +5 and +18V.

4.3 DETAILED CIRCUIT DESCRIPTIONS

Refer to the block diagram, Figure 4-1 as well as the detailed schematics provided in Section 7.

4.3.1 Attenuation Controller Board Assembly (See Figure 7-1)

The attenuation controller board assembly contains all of the 3210 circuitry.

4.3.1.1 Programmable Peripheral Interface

In the LOCAL operating mode the attenuation setting (ie 127dB) of the front panel thumbwheel switch S5 is applied to jack J1. Only nine of the sixteen J1 pins are used. The nine bit parallel transfer input data is applied to the programmable peripheral interface integrated circuit U7. The U7, P8255A, is a programmable peripheral interface device designed for use in the 8085 microprocessor family. Its function, within the attenuation controller assembly, is that of a generai purpose I/O (input/output) component to interface the thumbwheel switch and two front panel LEDS to the microprocessor data/address bus. The operation of U7 is controlled by the central processing unit (CPU) circuit U10 via the data/address bus. The output data of the thumbwheel switch is read by ports A and B of U7. Nine bit data from the thumbwheel switch is applied to the port A 8-bit data input latch and 1-bit of the port B data input latch. Specifically pins PA0 through PA7 and PB0 of U7. The data is read when the port is addressed, the chip is selected ($\overline{CS}$) and the processor applies on IO/$\overline{M}$ signal. Upon meeting the read conditions the U7 IC provides a data output through an internal data bus buffer circuit. The data is made available to the CPU on U7 pins D0 through D7 and is then transferred by the AD0 through AD7 data lines of the multiplexed data/address bus. For the purpose of maintaining circuit description continuity the data process of the CPU circuit will be described in paragraph 4.3.1.2 while this paragraph will continue with the programmable peripheral interface circuit description. Three pins of the eight pin port C output data latch are used to provide reset and inhibit signals to a timer integrated circuit and also drive two nand gate circuits. The output of port C pin PC2 is used as the resect and inhibit for timer IC U12. The PC2 output of U7 is generated in accordance with CPU instructions for controlling the front panel ATTENuation SET led DS1. The PC2 output is applied to pin 4 of IC U12, and thereby controls the U12 timing output signal on pin 3. The timing signal output of U12 is used to drive the LED DS1. Under this condition the square wave timing signal output of U12 is applied to the cathode of the DS1 led. Therefore the DS1 LED will flash on and off in accordance with the changing levels of the square wave at the catholde and the +5 volt potential applied to the anode through R4. A low on pin 3 of U12 will cause the constant illumination of DS1. The PCO output of U7 is applied to pin 10 of the quad NAND gate IC U5. The U5 NAND gate which contains pins 8, 9 and 10 is used to control the front panel REMOTE LED DS2. A low on the NAND gate output will cause the LED to illuminate. When the front panel toggle switch is set to REMOTE, the REN line is active and an MLA (My Listen Address) is sent. The CPU instructions, in conjunction with the REMOTE switch setting, control the PCO signal output of U7. The purpose of the U7 output PC1 is similar to that of PCO. The PC1 output controls the front panel LISTEN led DS3 via the U5 NAND gate containing pins 11, 12 and 13 in accordance with the following. The NAND gate output is high, turning the LED off when one of the following happens.

1. The switch is set to LOCAL
2. When GTL is sent from the remote controller
3. When the REN line is inactive
4. When the bus cable is disconnected
5. When UNL or MTA is sent from the controller.

The DS3 LED is on in the REMOTE mode when a MLA is sent by the controller. The LISTEN LED provides a front panel indication of the 3210 used as a listener device during REMOTE mode operation.

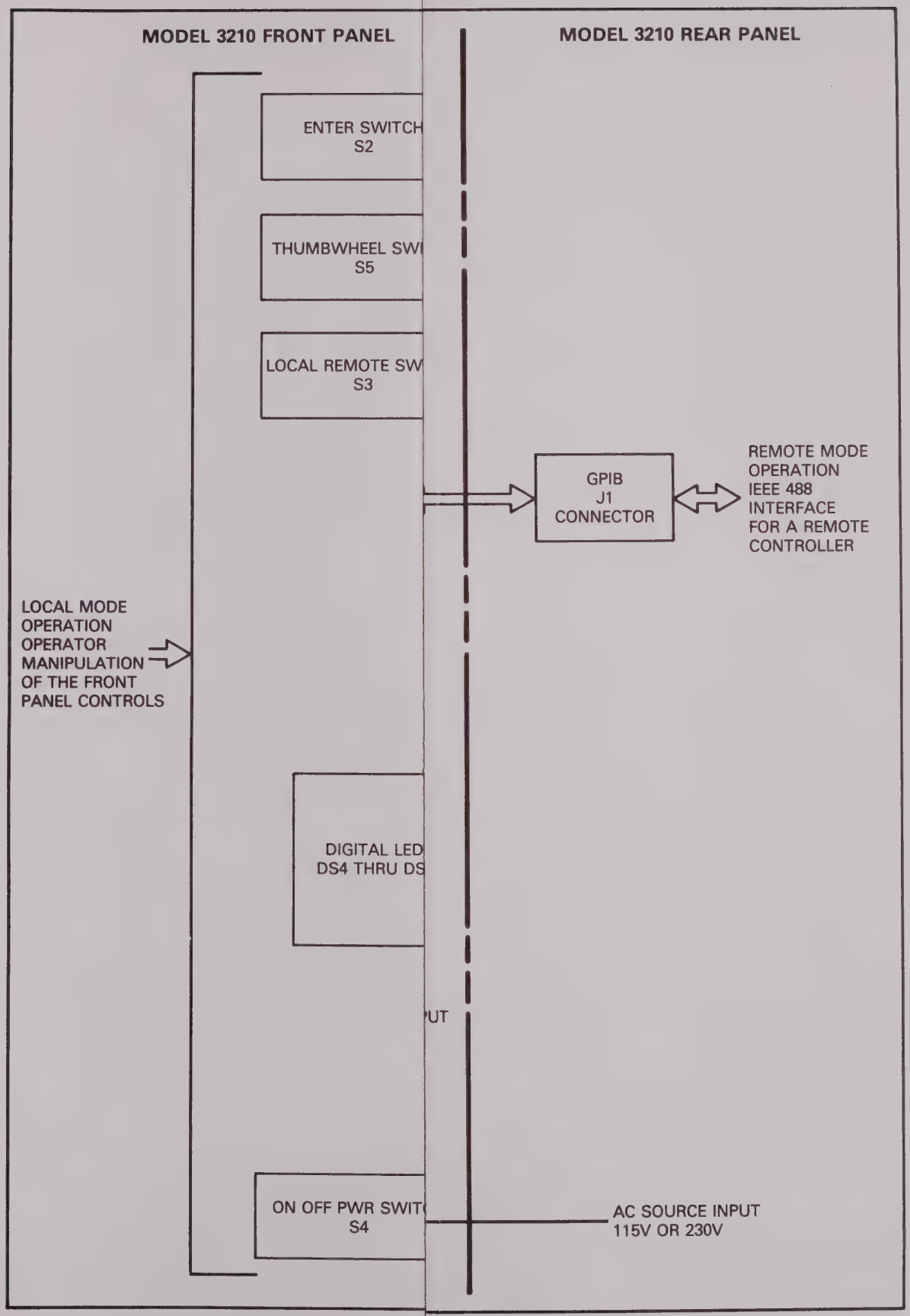

Figure 4-1. Model 3210 Overall Block Diagram

4.3.1.2 Central Processing Unit

The U10 IC of the attenuation controller assembly is the central processing unit. This circuit is the center of control for the multiplexed data/address bus, and therefore the control center for the 3210 in both modes of operation. The U10 IC communicates with the controller assembly circuitry through the 16 bit data/address bus (AD0 through A15). The address is split between the 8 bit data bus (AD0 through AD7) and the 8 bit address bus (A8 through A15). The A11 and A12 address bits are not used in the 3210 circuitry. Digital information is passed to and from the U10 integrated circuit in accordance with instructions residing in the Read Only Memory (ROM) of integrated circuit U4, via the data/address bus. The microprocessor system of the 3210 includes the CPU IC U10, the I/O ICs U7 and U11 and the ROM IC U4. One of the ports of the U7I/O or the U11 I/O circuit is used as a temporary memory which stores the 3210 operating parameters (ie attenuation setting) in their respective operating modes. The ROM circuit provides a permanent storage memory for the microprocessor control program. The control program contains the operating instructions which are used by the U10 IC to process the operating parameters and thereby control the 3210 circuitry. The CPU IC U10 addresses the memory via the 16 bit data/address bus in order to fetch instructions (ROM) and operating parameter data from I/O ports and IEEE 488 periperhals (temporary memory). In addition to the address bus, the CPU also uses read ($\overline{RD}$), or write ($\overline{WR}$) control signals to communicate. A read signal initiates transfer of data from the bus to the CPU U10 from a location indicated by the address. A write signal indicates that the CPU is ready to transmit data to the selected memory or I/O circuit and that the data bus is available for data transfer. The chip select signal activates a specific IC. The combination of control signals and derived data of the CPU are distributed in accordance with the control program. The control program is a sequential set of instructions. When the 3210 is energized the U10 IC will start the control process at the first instruction and continue with the sequential instructions of the program unless an interrupt signal is received. The CPU IC provides for five interrupt signals. However only two are used for the 3210 application. Restart interrupt signals RST 5.5 and RST 6.5 are applied to the U10 IC on pins 9 and 8. RST 6.5 is the higher priority interrupt, and it is the output of the front panel ENTER control. RST 5.5 is output from pin 11 of the U11 IC and is the interrupt associated with GPIB activity. The effect of an interrupt signal is to cause a program jump. A program jump instruction directs the U10IC to break the sequential order of the control program and jump to an instruction as directed by the interrupt. In this manner the CPU will accommodate front panel or remote control changes in the 3210's operating parameters. In the LOCAL operating mode the +5 volt pulse induced by the front panel ENTER control (momentary switch S2) is applied to pin 8 of U10. This interrupt will cause the CPU to acknowledge the last attenuation setting of the thumbwheel switch and change the attenuation of the 3200 attenuator via the circuit directives that follow. Both restart interrupt signals allow for an automatic restart of the program when the interrupt process is complete. This restart is a return to the program instruction which follows the interrupt jump instruction. The $\overline{RESET\ IN}$ signal applied to pin 36 of U10 will direct the CPU to return to the first instruction of the program. This restart is a function of the 3210 energizing process and will occur each time the ON OFF PWR switch is set to ON. The 6.144 MHz output of crystal y1, applied to U10 on pins 1 and 2, provides a clock signal for the internal clock generator of the CPU, as well as the rest of the system. This completes the CPU circuit description.

4.3.1.3 Read Only Memory (ROM)

The U4 read only memory integrated circuit is a C8755A EPROM I/O. The circuit is programmed at the Weinschel Engineering Company facilities and thereby provides the control program which is used by the CPU as described in paragraph 4.3.1.2. The program data is fetched by the microprocessor. The eight bit port A (PA0 through PA7) output data latch is used to transfer data to the U1 driver circuit. In accordance with the input data the driver circuit will activate the 3200 attenuator and the front panel digital leds (DS4 through DS11) via the output on pins 12 through 18. The port A output to the driver circuit provides the same function in the LOCAL and REMOTE modes of operation. For REMOTE mode operation the eight bit port B (PB0 through PB7) input data latch is used to read the 3210 address for GPIB reference. The address is set by the seven positions on dip switch S1. This 3210 address is used by the remote controller to differentiate the 3210 from other peripheral equipment within the controller's system. This address resides within the U11 IC and is matched with the controller's address. The IEEE 488 interface provides the final circuit path between the 3210 and the remote controller.

4.3.1.4 GPIB Talker/Listener

The U11 GPIB talker/listener integrated circuit is a P8291A I/O designed to interface the microprocessor with the IEEE 488 interface. Multiplexed data/address lines AD0 through AD7 transfer bidirectional data between the CPU and the D0 through D7 data bus port of U11 in accordance with the control signals $\overline{CS}$, $\overline{RD}$ and $\overline{WR}$ and the address lines A8, A9 and A10. The three address lines are applied to the RS0 through RS2 register select inputs of U11. These signals provide CPU control of the U11 IC. The INT (interrupt) output of U11 will cause the CPU to service a remote controller interrupt. This signal is the RST 5.5 interrupt applied to the CPU on pin 9. The CPU will service this interrupt in accordance with the interrupt priority structure described in paragraph 4.3.1.2. The 8 bit $\overline{DIO1}$ through $\overline{DIO8}$ GPIB data port is used for bidirectional data byte transfers between U11 and the U8 and U9 IC transceiver circuits. The T/R1 and T/R2 signal lines control the data byte transfers. When T/R1 is set high data is applied to the transceiver circuits via the $\overline{DIO1}$ through $\overline{DIO8}$ data port. When T/R1 is set low data is applied to U11 via the data port. The T/R1 control line operates in conjunction with the IEEE-488 data byte transfer control (handshake) signals $\overline{DAV}$, $\overline{NRFD}$ and $\overline{NDAC}$. Refer to the data transfer flow diagram, Figure 4-2 for an illustration of a data byte transfer. The $\overline{EOI}$ signal line is used to indicate the end of a multiple byte transfer sequence between U11 and the transceivers. The U8 and U9 transceiver circuits receive or transmit the data and control signals of the U11 IC to the remote controller. Refer to Table 4-1 for the IEEE-488 definitions of the 16 lines within the interface and a number of definitions on bus concepts. Also refer to schematic Figure 7-2. The schematic provides an illustration of the IEEE 488 bus wiring on jack J1. Data transmission on the bus is asynchronous, bidirectional and coded in ASCII.

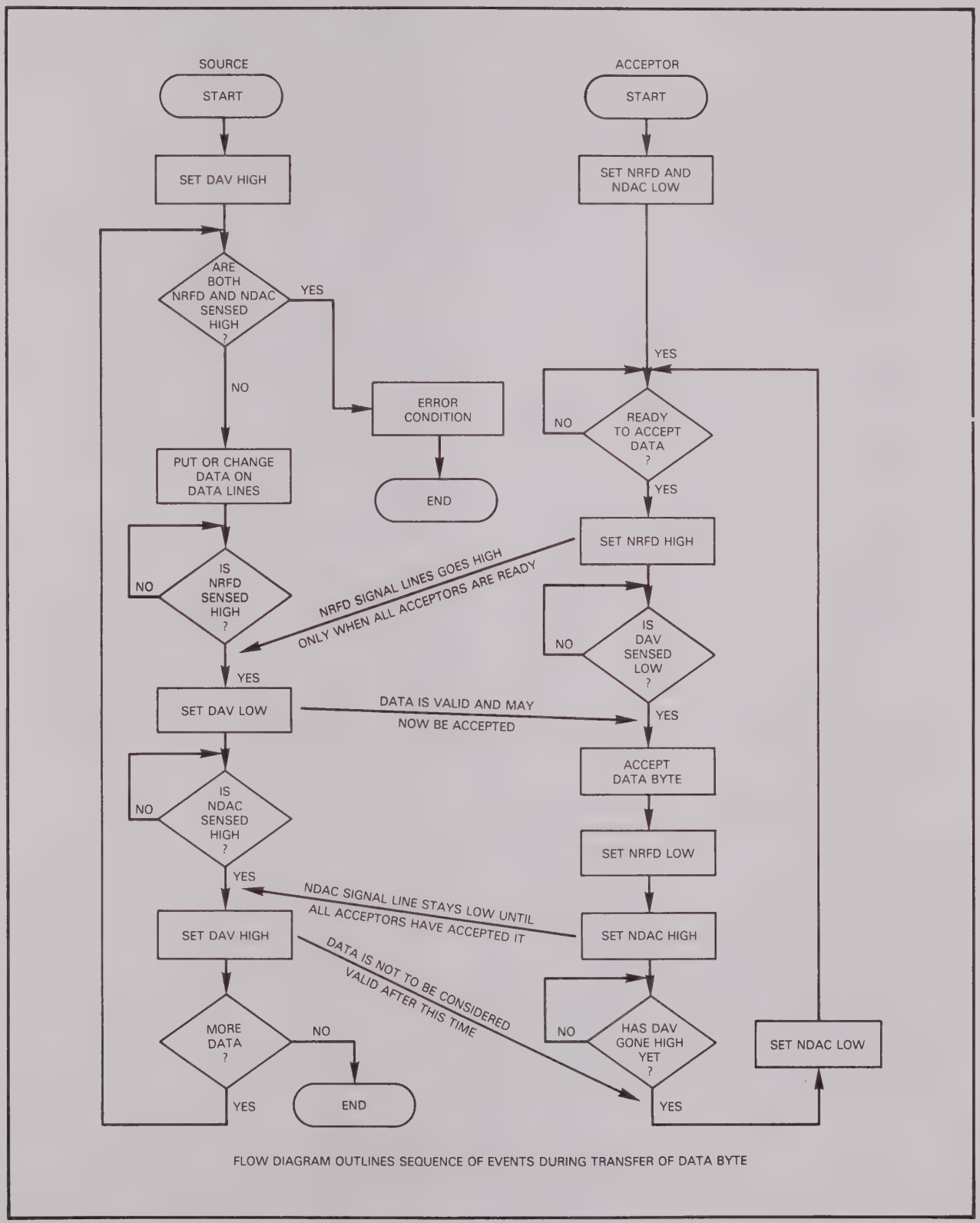

Figure 4-2. Data Transfer Flow Diagram

TABLE 4-1. IEEE DEFINITIONS

16 LINES OF THE IEEE-488 INTERFACE BUS	BUS CONCEPTS
DI01-DI08 Data Input/Output — These are the message lines for carrying data in a bit-parallel, byte-serial form. Data is asynchronous and generally bidirectional. These lines carry either data or address information, depending on the condition of the ATN line. **DAV (Data Valid)** — One of the three Handshake lines used to indicate availability and validity of information on the DIO lines. DAV indicates to the acceptor(s) that data is available on the DIO lines. **NRFD (Not Ready for Data)** — Another Handshake line used to indicate that all devices are or are not ready to accept data. **NDAC (Not Data Accepted)** — The final Handshake line used to indicate the acceptance of data by all devices. **ATN (Attention)** — One of five bus management lines used to specify how data on the data lines are to be interpreted and which devices must respond to the data. When ATN is true the DI01-8 lines carry addresses or commands. When false they carry data. (Controller driven.) **IFC (interface Clear)** — A bus management line which is used to place the interface system in a known quiescent state. All interconnected devices contain some portions of the interface system. IFC puts talkers, listeners into their idle states. (Controller driven.) **SRQ (Service Request)** — A bus management line used by a device to indicate a need for service and to request an interrupt of the current events sequence. **REN (Remote Enable)** — This management line in conjunction with other messages selects between two alternate sources of device programming data. (Example: front panel control or interface control.) (Controller driven.) **EOI (End Or Identify)** — The final management line used to indicate the end of multiple byte transfer sequences or with ATN to perform a parallel polling sequence.	**Bidirectional bus** — A bus used by any individual device for two-way transmission of messages, that is, both input and output. **Bit-Parallel** — Refers to a set of concurrent data bits present on a like number of signal lines used to carry information. Bit-parallel data bits may be acted upon concurrently as a group (byte) or indipendently as individual data bits. **Bus** — A signal line or a set of signal lines used by an interface system to which several devices can be connected and over which messages are carried. **Byte** — A group of adjacent binary digits operated on as a unit and usually shorter than a computer word (frequently connotes a group of eight bits). **Byte-Serial** — A sequence of bit-parallel data bytes used to carry information over a common bus. **ASCII** — Abbreviation for American Standard Code for Information Interchange (pronounced "ask-ee"). A standard code used extensively in data transmission, in which 128 numerals, letters, symbols, and special control codes are each represented by a 7-bit binary number. For example numeral 5 is represented by 011 0101, letter K by 100 1011, percent symbols (%) by 010 0101 and start of text (STX) control code by 000 0010.

4.3.1.5 Power Supply

AC source power of 115 volts or 230 volts is applied through the rear panel power cord to jack J3 of the attenuation controller assembly. The rear panel voltage select switch S6 is set in accordance with the available source. The secondary windings of step-down transformer T1 apply AC power to the diodes of two rectifier circuits. Diodes CR6 and CR7 make up a full wave rectifier circuit which provides a DC output from the AC input. The DC output is filtered by the discrete resistor and capacitor components which are connected across the rectifier. Regulation is provided by the voltage regulator U13. Zener diode CR4 maintains the DC output at +5 volts. The +18 volt DC output of the power supply is provided by the CR11 full wave bridge rectifier and the associated discrete components including regulator U14 and zener diodes CR8 and CR10. The DC output across CR8 is maintained at +18 volts.

4.4 MODEL 3210 MAIN CHASSIS (See Figure 7-2)

The overall schematic Figure 7-2 is an illustration of the attenuation controller board assembly wiring connections to the front panel controls and the rear panel connectors.

TABLE 4-2. Remote Message Mnemonics

Mnemonic	Message Title
ATN	Attention
DAB	Data Byte
DAC	Data Accepted
DAV	Data Valid
DCL	Device Clear
END	End
GET	Group Execute Trigger
GTL	Go To Local
IDY	Identify
IFC	Interface Clear
LLO	Local Lockout
MLA	My Listen Address
[MLA]	My Listen Address
MSA or [MSA]	My Secondary Address
MTA	My Talk Address
[MTA]	My Talk Address
OSA	Other Secondary Address
OTA	Other Talk Address
PCG	Primary Command Group
PPC	Parallel Poll Configure
[PPD]	Paralle Poll Disable
[PPE]	Parallel Poll Enable
PPRn	Parallel Poll Response n
PPU	Parallel Poll Unconfigure
REN	Remote Enable
RFD	Ready For Data
RQS	Request Service
[SDC]	Selected Device Clear
SPD	Serial Poll Disable
SPE	Serial Poll Enable
SRQ	Service Request
STB	Status Byte
TCT or [TCT]	Take Control
UNL	Unlisten

SECTION 5
MAINTENANCE

5.1 INTRODUCTION

Built with high reliability solid-state components, the Model 3210 requires no calibration and little maintenance. Circuits are straightforward and simple in design. Performance verification is accomplished during the course of normal operation. Should improper performance be apparent during normal operation, the trouble can be isolated by studying the schematic diagrams in Section 7, and referring to the circuit descriptions provided in Section 4. If parts replacement is required, refer to Section 6.

This section provides required preventive maintenance for the Model 3210.

5.2 PREVENTIVE MAINTENANCE

While the 3210 requires little preventive maintenance, it should not be subjected to physical abuse, severe shock, high temperature nor high humidity levels, and should be kept free of excessive dirt and dust.

To remove dirt or dust, use a slightly dampened lint-free cloth. Occasionally check cables, leads, and connectors for signs of cracked insulation and bent or worn pins. Interior dust may be blown out using a low pressure air blower.

SECTION 6
REPLACEABLE PARTS

6.1 INTRODUCTION

This section provides information for procuring replaceable parts for the Model 3210. The parts listed include all parts subject to burnout, breakage or deterioration during normal operation of the equipment.

6.2 REFERENCE DESIGNATIONS

All reference designations for electrical parts are preceded by a prefix which indicates the assembly in which the part is contained. Table 6-1 and Figure 6-1, identifies, and locates, each assembly by name and reference designation.

6.3 ORDERING INFORMATION

The following information should be included when ordering replacement parts.

a. Weinschel Engineering part number and description of part.

b. The instruments model number and serial number.

c. If ordering a part not included in the replaceable parts list, include a complete description of part, its functions and its location within the equipment.

d. 1N914 and 1N3064 diodes are interchangeable; either may be listed in the parts lists.

6.4 PARTS LIST

A list of parts for each unit and assembly is provided in Tables 6-1 and 6-2.

Component location drawings (Figures 6-1 and 6-2) are provided adjacent to their applicable parts list.

6.5 MANUFACTURER CODES

The manufacturer codes are identified in Appendix A of this manual.

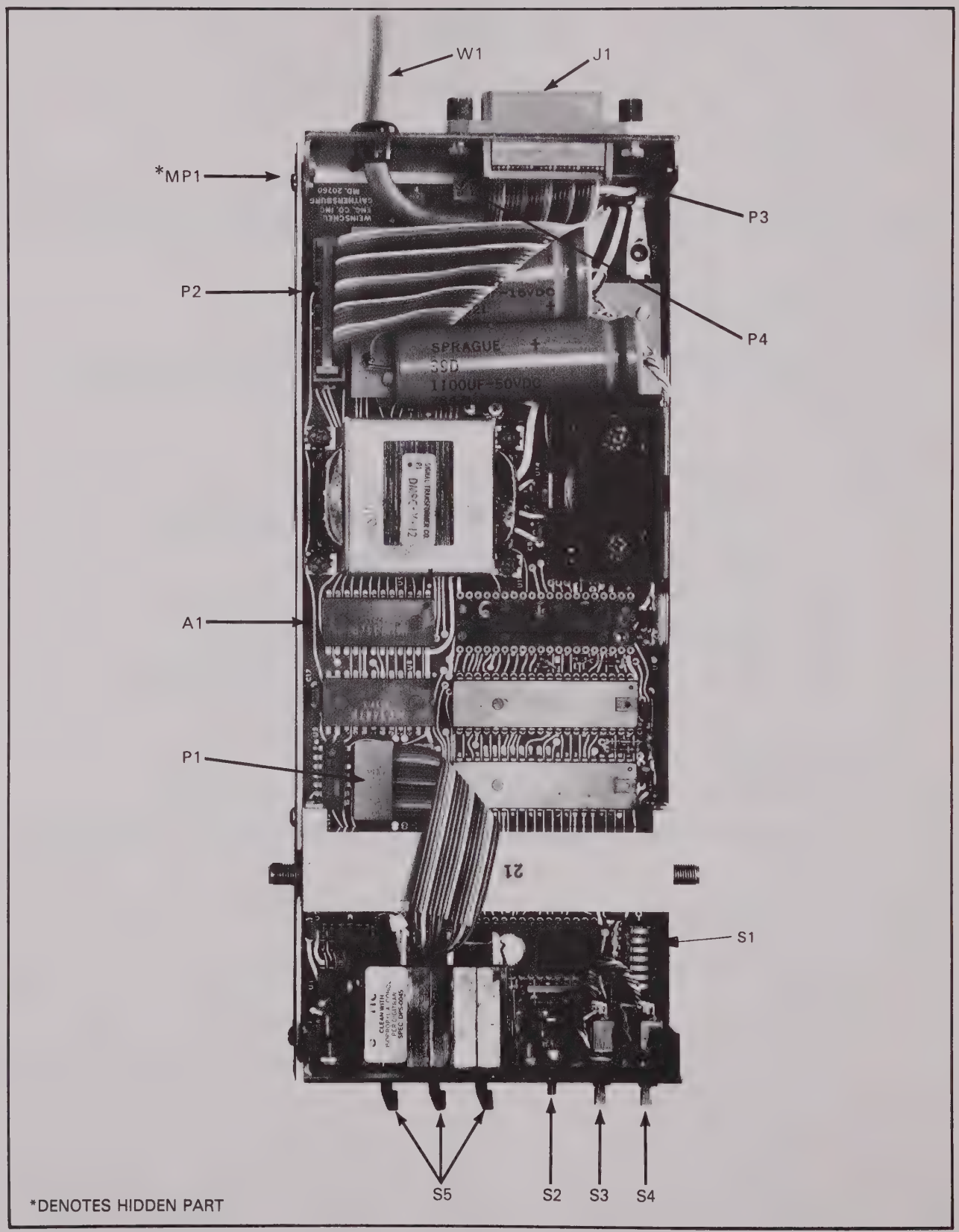

Figure 6-1. Model 3210 Main Assembly, D101-1208, Rev. B

Table 6-1. Model 3210, Main Assembly Parts List, 101-1208, Rev. B

REF. DES.	DESCRIPTION	WEINSCHEL PART NO.	MFG. PART NO.	MFG. CODE
A1	ATTENUATION CONTROLLER BOARD ASSY	101-1156		93459
J1	CONNECTOR, 24 PIN	062-219-2	609-24F	95960
MP1	BUMPER RUBBER	074-12	2193	83330
P1	CONNECTOR 16 PIN	061-64	609-M165H	95960
P2	CONNECTOR 26 PIN POLARIZED	062-233-26	609-1030-26	95960
P3	CONNECTOR 3 POSITION HOUSING	062-216-3	87159-4	13511
P4	CONNECTOR 6 POSITION HOUSING	062-216-6	87159-6	13511
S2	SWITCH PUSH BUTTON (ENTER)	055-72	39-1	81073
S3	SWITCH TOGGLE (LOCAL REMOTE)	055-70	7101P4PYZBE	09353
S4	SWITCH TOGGLE (ON/OFF PWR)	055-70	7101P4PYZBE	09353
S5	SWITCH THUMBWHEEL (ATTENUATION dB)	055-76		93459
W1	CABLE POWER	068-15	172371B	16428

Table 6-2. Assembly A1, Attenuation Controller Board Parts List, 101-1156, Rev. B

REF. DES.	DESCRIPTION	WEINSCHEL PART NO.	MFG. PART NO.	MFG. CODE
A1	ATTENUATION CONTROLLER BOARD ASSY	101-1156		93459
C1	CAPACITOR DIP 33PF 5% 500V	034-30-330	CM05ED330J03	01884
C2	CAPACITOR DIP 33PF 5% 500V	034-30-330	CM05ED330J03	01884
C3	CAPACITOR TANT 10UF 10% 20V	031-111-106	T368A106	05397
C4	CAPACITOR TANT 1.0 UF 10% 20V	031-111-105	T368A105	05397
C5	CAPACITOR TANT 1.0 UF 10% 20V	031-111-105	T368A105	05397
C6	CAPACITOR CER 0.1 UF 10% 50V	034-27-104	CK05BX104K	81349
C7	CAPACITOR TANT 4000 UF 25% 15V	031-83	390408G015JL4	01884
C8	CAPACITOR CER 0.1 UF 10% 50V	034-27-104	CK05BX104K	81349
C9	CAPACITOR CER 47 UF 10% 50V	034-28-474	CK06BX474K	81349
C10	CAPACITOR TANT 1100 UF 20V	031-88	39D118C050HP4	01884
C11	CAPACITOR CER .01 UF 10% 100V	034-27-103	CK05BX103K	81349
C12	CAPACITOR CER .22 UF 10% 100V	034-28-224	CK06BX224K	81349
C13	CAPACITOR CER 0.1 UF 10% 50V	034-27-104	CK05BX104K	81349
C14	CAPACITOR CER 0.1 UF 10% 50V	034-27-104	CK05BX104K	81349
C15	CAPACITOR CER 0.1 UF 10% 50V	034-27-104	CK05BX104K	81349
C16	CAPACITOR CER 0.1 UF 10% 50V	034-27-104	CK05BX104K	81349
C17	CAPACITOR CER 0.1 UF 10% 50V	034-27-104	CK05BX104K	81349
C18	CAPACITOR CER 0.1 UF 10% 50V	034-27-104	CK05BX104K	81349
C19	CAPACITOR CER 0.1 UF 10% 50V	034-27-104	CK05BX104K	81349
CR1	DIODE	012-293	IN4002	07688
CR2	DIODE	012-293	IN4002	07688
CR3	DIODE	012-51	IN3064	07688
CR4	DIODE ZENER 6.8V	012-356	UZ5706	12969
CR5	DIODE	012-293	IN4002	07688
CR6	DIODE	012-293	IN4002	07688
CR7	DIODE	012-293	IN4002	07688
CR8	DIODE ZENER 22V	012-241	UZ5722	52306

Table 6-2. Assembly A1, Attenuation Controller Board Parts List, 101-1156, Rev. B (Continued)

REF. DES.	DESCRIPTION	WEINSCHEL PART NO.	MFG. PART NO.	MFG. CODE
CR9	DIODE	012-293	IN4002	07688
CR10	DIODE ZENER 47V	012-357	IN5368A	07688
CR11	DIODE BRIDGE RECTIFIER	012-166	MDA920A-3	04713
DS1	LED GREEN	012-349	5082-4190	28480
DS2	LED RED	012-314	HLMP-6620	28480
DS3	LED RED	012-314	HLMP-6620	28480
DS4	LED RED	012-314	HLMP-6620	28480
DS5	LED RED	012-314	HLMP-6620	28480
DS6	LED RED	012-314	HLMP-6620	28480
DS7	LED RED	012-314	HLMP-6620	28480
DS8	LED RED	012-314	HLMP-6620	28480
DS9	LED RED	012-314	HLMP-6620	28480
DS10	LED RED	012-314	HLMP-6620	28480
DS11	LED RED	012-314	HLMP-6620	28480
F1	FUSE 1/4A (115V)	052-1-1/4	312.250	71400
F1	FUSE 1/8A SLO-BLO (230V)	052-1-1/8SB	313.125	71400
J1	IC SOCKET 16 PIN	061-69	ME-2B-16-SW-G-B-10	18677
J2	CONNECTOR 26 PIN	062-234-26	609-2627ES-26	95960
J3	CONNECTOR 3 PIN	062-231-3	87633-3	13511
J4	CONNECTOR 6 PIN	062-231-6	87633-6	13511
R1	RESISTOR 4.7K 5% 1/4W	025-25-4700	RC07GF472J	81349
R2	RESISTOR 100K 5% 1/4W	025-25-100K	RC07GF104J	81349
R3	RESISTOR 1K 5% 1/4W	025-25-1000	RC07GF102J	81349
R4	RESISTOR 240 OHM 5% 1/4W	025-25-240	RC07GF241J	81349
R5	RESISTOR 619K 1% 1/10W	025-30-6193	RN55C6193F	81349
R6	RESISTOR 619K 1% 1/10W	025-30-6193	RN55C6193F	81349
R7	RESISTOR 33K 5% 1/4W	025-25-33K	RCR07GF333J	81349
R8	RESISTOR 237 OHM 1% 1/4W	025-33-2370	C4237R 1%	14674
R9	RESISTOR 715 OHM 1% 1/4W	025-33-7150	C4715R 1%	14674
R10	RESISTOR 500 OHM 5W	026-6-50	RS-5-50-5	91637

Table 6-2. Assembly A1, Attenuation Controller Board Parts List, 101-1156, Rev. B (Continued)

REF. DES.	DESCRIPTION	WEINSCHEL PART NO.	MFG. PART NO.	MFG. CODE
R11	RESISTOR 4.7K 5% 1/4W	025-25-4700	RC07GF472J	81349
R12	RESISTOR 33K 5% 1/4W	025-25-33K	RCR07GF333J	81349
S1	SWITCH DIP 7 POSITION (ADDRESS)	055-63	435626-4	00779
S6	SWITCH SLIDE (VOLTAGE SELECT)	057-19	EPS2-PC3	82389
T1	TRANSFORMER	040-185	DMPC-Y-12	08779
U1	IC SOURCE DRIVER	015-02-2981	UDN-2981A	56289
U2	RESISTOR NETWORK 470 OHM	028-11-471	4116R-001	80294
U3	RESISTOR NETWORK 4.7K	028-07-472	4308R-101	80294
U4	IC EPROM I/O	101-1233	C8755A	34649
U5	IC QUAD 2 INPUT NAND	015-10-00	SN74LS00N-00	04713
U6	RESISTOR NETWORK 4.7K	028-13-472	4116R-002	80294
U7	IC PROGRAM PERIPHERAL INTERFACE	015-12-8255	P8255A	34649
U8	IC TRANSCEIVER	015-02-3447	MC3447L	04713
U9	IC TRANSCEIVER	015-02-3447	MC3447L	04713
U10	IC MICROPROCESSOR CPU	015-12-8085	P8085A-2	34649
U11	IC GPIB TALKER/LISTENER	015-12-8291	P8291A	34649
U12	IC TIMER	012-272	MC1455P1	04713
U13	VOLTAGE REGULATOR	15-07-LM317K	LM317K	27014
U14	VOLTAGE REGULATOR	15-07-LM7818	LM7818CT	27014
W1	WIRE BUSS	079-26-3	8021	16428
W2	WIRE 22 AWG BRN	079-89-001		93459
W3	WIRE 22 AWG YELLOW	079-89-004		93459
W4	WIRE 22 AWG RED	079-89-002		93459
W5	WIRE 22 AWG ORANGE	079-89-003		93459
W6	WIRE 22 AWG BLACK	079-89-00		93459
Y1	CRYSTAL 6.144 MHZ	012-364	MP061	04713
XF1	FUSE CLIP	074-679	MC-27	26364
XU4	IC SOCKET 40 PIN	061-85-40	540-AG19D	91506
XU10	IC SOCKET 40 PIN	061-85-40	540-AG19D	91506
XU13	TRANSISTOR SOCKET	061-56	8080-1G1	91506

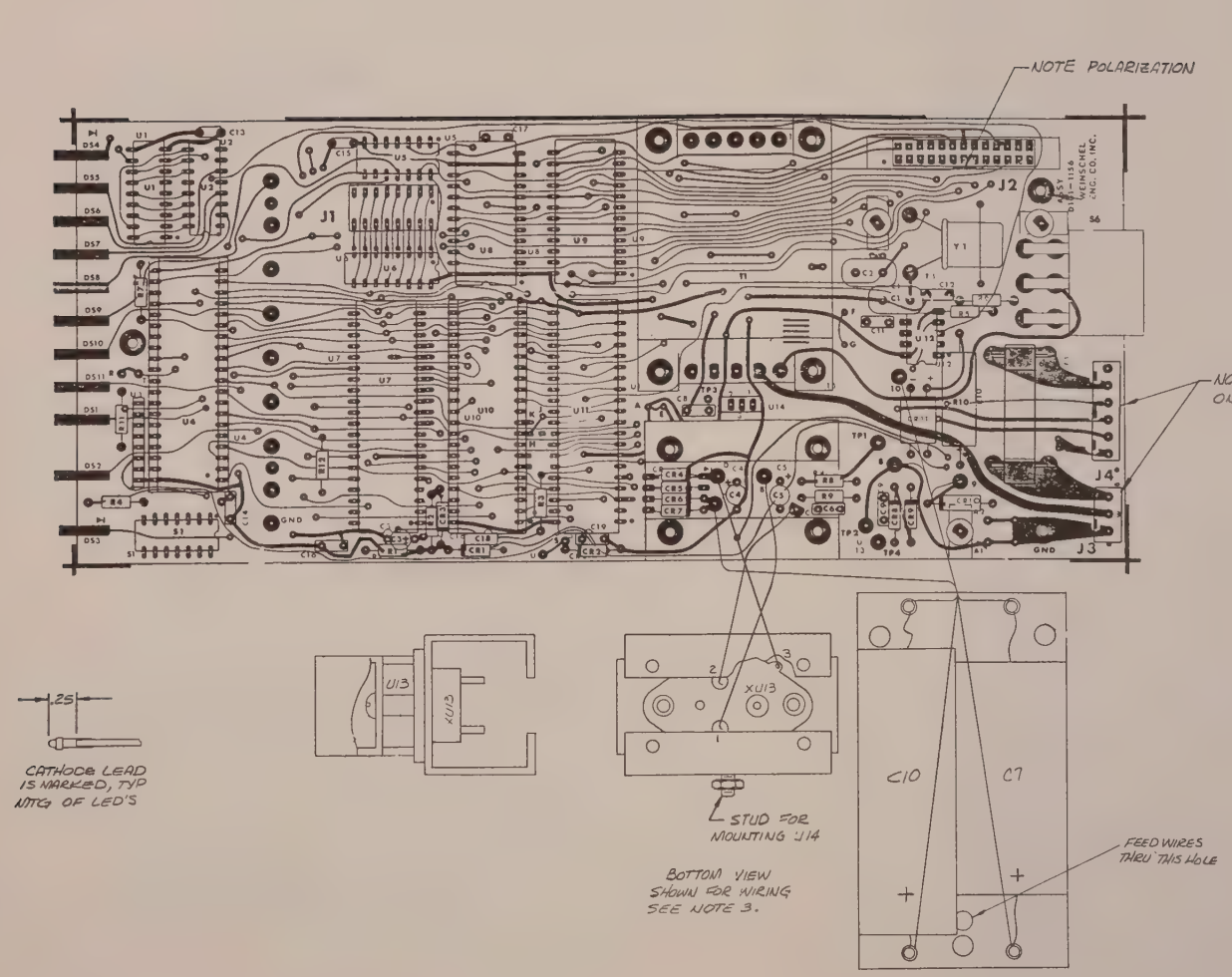
NOTES:
1- USE RTV TO HOLD DOWN CAPACITORS C7 & C10 LOCATE C10 TO CLEAR BOARD MTG HOLES
2 - FOAM TAPE TO BE INSTALLED UNDER AND OVER T1.
3- FOAM TAPE TO BE INSTALLED UNDER HEATSINK FOR U13.
⚠ INSTALL JUMPER AT TEST.
NOTE POLARIZATION
NOTE KEY POSITIONS ON J3 & J4
J1
J2
J3
J4
.25
CATHODE LEAD IS MARKED, TYP MTG OF LED'S
U13
XU13
STUD FOR MOUNTING U14
BOTTOM VIEW SHOWN FOR WIRING SEE NOTE 3.
C10
C7
FEED WIRES THRU THIS HOLE

Figure 6-2
Model 3210 Assembly A1, Attenuation Controller Board, Component Location, D101-1156, Rev. C

Weinschel

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FAX TRANSMISSION COVER SHEET

Date: **6 November 1997**

To: **ARGO**
Mike Bloomberg

Subj.: **3210 IEEE information**

Ref: **Telephone conversation of 5 Nov. 1997**

Sender: **WALTER DERONDE**

YOU SHOULD RECEIVE 1 PAGE(S), INCLUDING THIS COVER SHEET.
IF YOU DO NOT RECEIVE ALL THE PAGES, PLEASE CALL 301-831-4701

Dear Mike,

Attached is the information I have regarding the IEEE commands for the 3210 controller.

Best Regards,

Walter DeRonde
Calibration and Service Manager

SECTION 7
DIAGRAMS

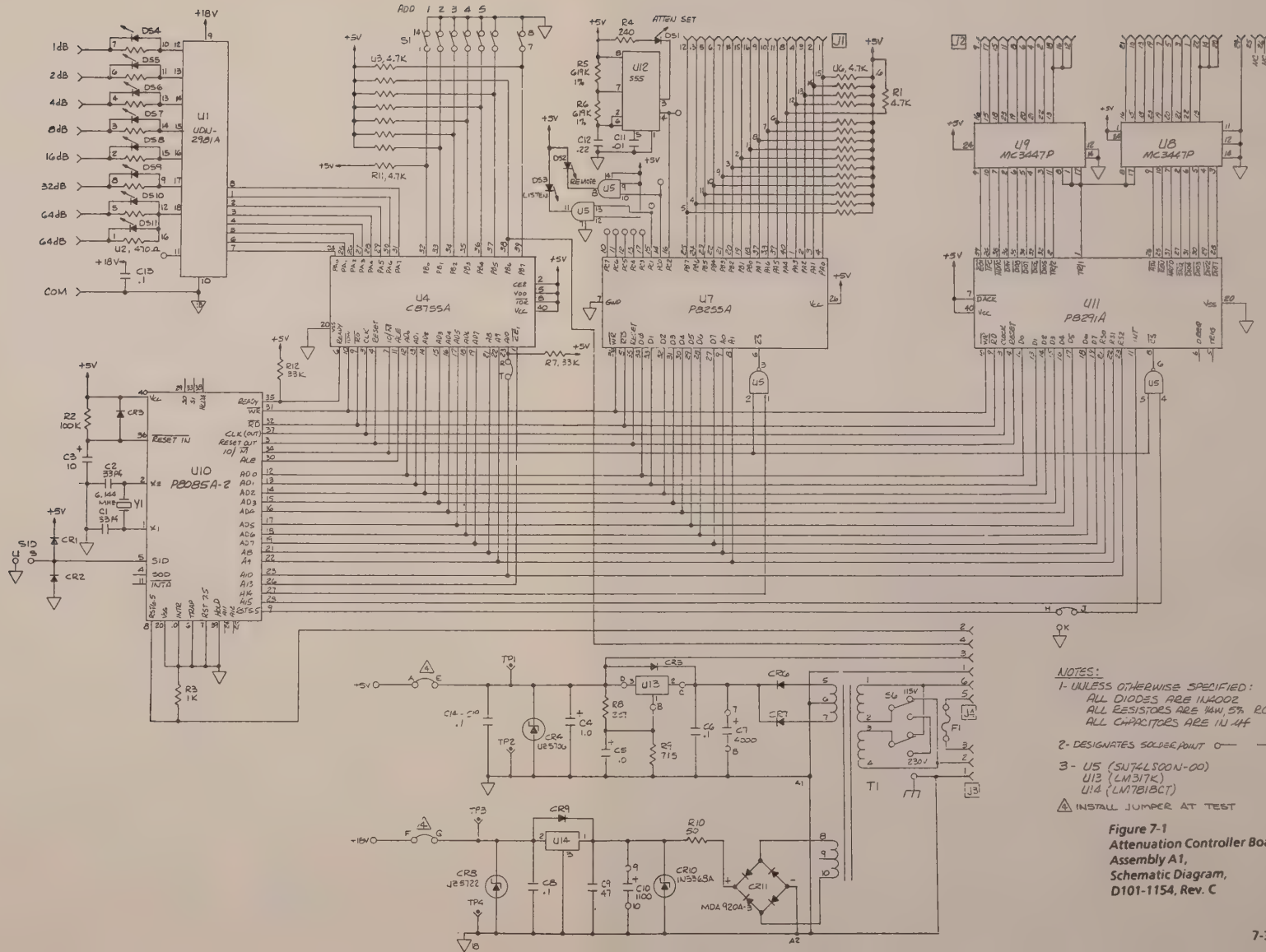
7.1 INTRODUCTION

This section contains schematic diagrams for the Model 3210 assemblies and subassemblies. Refer to the component location drawings and corresponding parts list in Section 6.

7.2 LIST OF FIGURES

The following is a list of figures included in this section.

Figure No.	Description	Page No.
7-1	Attenuation Controller Board, Assembly A1, Schematic Diagram	7-3/7-4
7-2	Model 3210 Overall Schematic Diagram	7-5/7-6



NOTES:

1- UNLESS OTHERWISE SPECIFIED:
ALL DIODES ARE IN4002
ALL RESISTORS ARE 1/4W, 5% RCO7
ALL CAPACITORS ARE IN 4F

2- DESIGNATES SOLDER POINT

3- U5 (SN74LS00N-00)
U13 (LM317K)
U14 (LM78I8CT)

4 INSTALL JUMPER AT TEST

Figure 7-1
Attenuation Controller Board, Assembly A1, Schematic Diagram, D101-1154, Rev. C

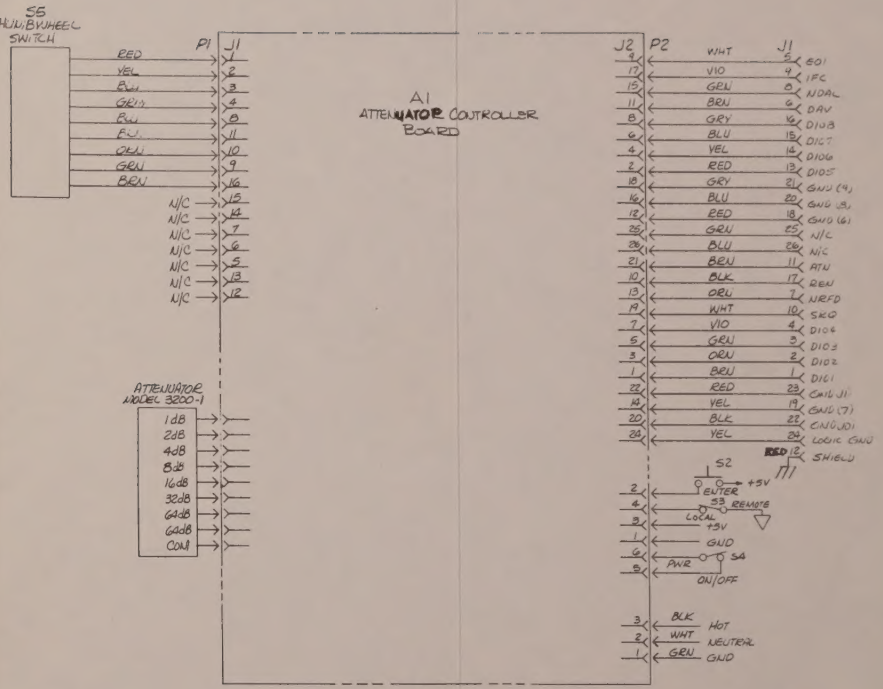


Figure 7-2
Model 3210
Overall Schematic Diagram
D101-1235, Rev. B

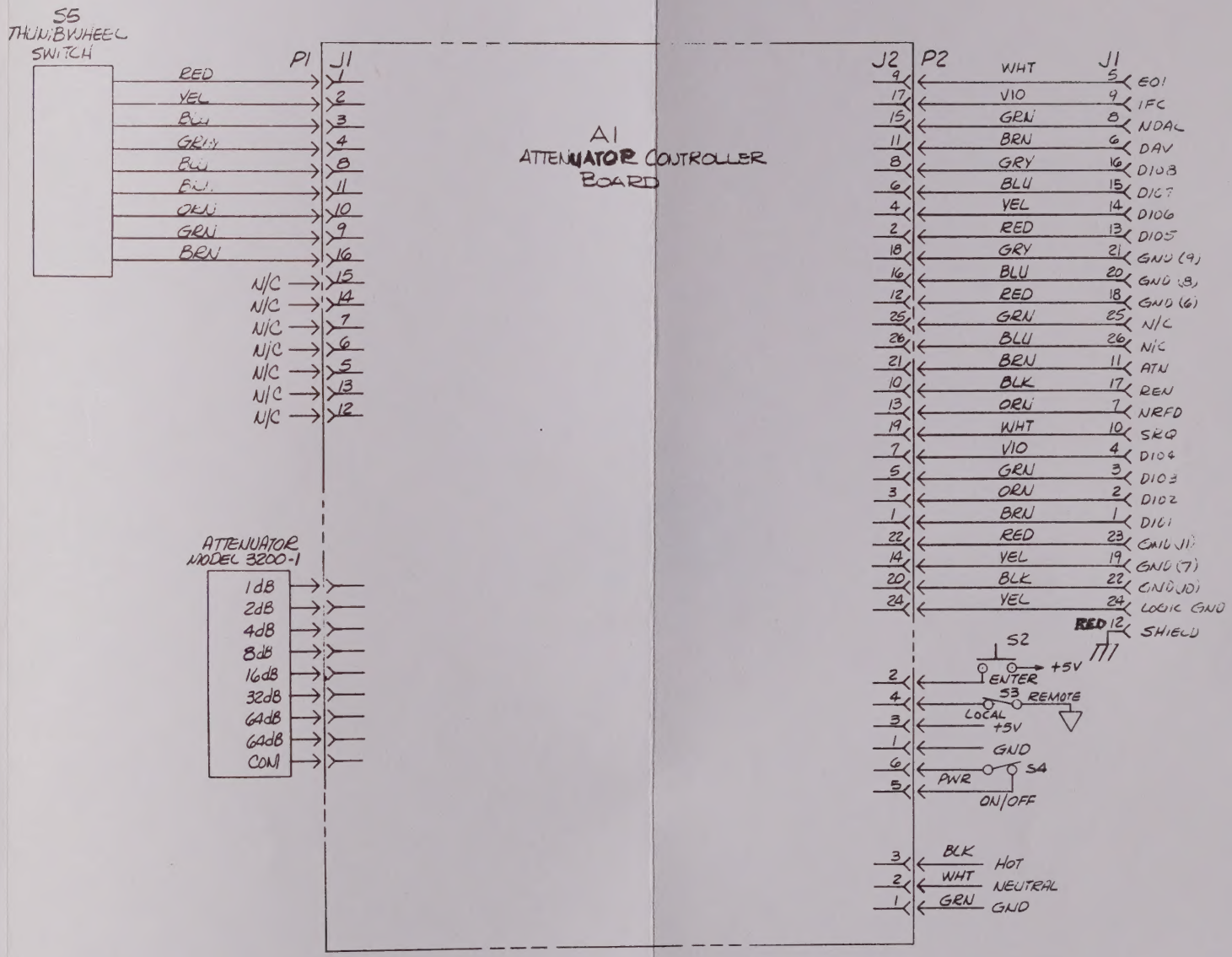


Figure 7-2
Model 3210
Overall Schematic Diagram
D101-1235, Rev. B

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